

CLIMATIC CHANGES IN WESTERN AMERICA¹

It is now more than 10 years since Ellsworth Huntington first employed the growth rings of the big trees of California to demonstrate the existence of variations of rainfall during the past 4,000 years. The chief difficulty has been the conversion of the curve of tree growth into a curve of rainfall. Trees grow more rapidly when they are young than when they are middle-aged, while in old trees the growth becomes irregular, so that the equation connecting tree-growth and rainfall at the present day can not be applied with safety to the early rings of the very oldest trees. Huntington, fresh from an investigation of climatic changes in western Asia, read into the tree-growth curve a close similarity to the fluctuations of level of the Caspian and applied a "Caspian correction factor" to the curve of tree-growth. The early levels of the Caspian are themselves very problematical, however, and the extrapolation to western America did not inspire confidence.

A more trustworthy control has now been supplied by the variations in the level of the salt lakes of the Great Basin in close proximity to the trees. It is well known that during the Pleistocene Ice Age the Great Basin was occupied by a number of lakes, of which the largest have been termed Lakes Bonneville and Lahontan. This was many thousand years ago, but some investigations carried out by J. Claude Jones into the salt content of Lakes Pyramid and Winnemucca, which occupy part of the old basin of Lake Lahontan, show that these lakes have been accumulating salt for a period probably between 2,500 and 3,000 years, so that at some date between 1,000 and 500 B. C. they consisted of fresh water. A lake formerly salt may become fresh either by overflowing or by becoming dry for a period long enough for the salt deposit to be covered by a thick layer of detritus. There is no evidence that the lakes have ever overflowed, so that we must adopt the second alternative and suppose that a long dry period ended between 1,000 and 500 B. C. If J. C. Jones had left the matter there he would have done much to assist the study of climatic changes, but, unfortunately, he has confused the deposits of the old Pleistocene Lake Lahontan with those of the modern lakes and has marred his work by some unwarranted statements as to the survival of the lion, horse, and camel in North America into historic times.

In the same publication E. Antevs has made a thorough revision of Huntington's data of tree growth and has prepared a series of curves corrected for the various sources of error from intrinsic evidence only. His various curves for damp and dry localities agree well among themselves and seem to establish the reality of the climatic fluctuations, though they still leave the absolute level of the early part of the record in some doubt. These curves point to a rapid increase of rainfall about 850 B. C. This evidently corresponds with the formation of the modern Lakes Pyramid and Winnemucca; about that date the rainfall must have increased from less to more than its present value, and we can adjust the level of Antevs's curves accordingly. Various other points can be determined from a study of the terraces formed during different stages in the history of these and other lakes;

for example, the salt content of Owens Lake shows that it became fresh rather more than 2,000 years ago, in this case by rising to such a high level that it overflowed, indicating that a peak on the corrected tree-growth curve at 450 B. C. was the absolute maximum of the whole curve. The age of Lake Walker is estimated as 800 to 900 years, and it can be shown that this lake originated with some changes in the drainage during a period of increased rainfall. A peak on the tree-growth curve fixes this maximum, second only to that of 450 B. C., at A. D. 1000. The corresponding high-level beach can be recognized in the Lahontan Basin, and we find that between these two maxima sub-aerial deposits extended below the present level of Lakes Pyramid and Winnemucca, pointing to a rainfall below the present; the tree curve dates this as A. D. 650 to 850. Finally, a tree killed by the rising salt water of Lake Mono was 500 years old, showing that the rainfall has been slight since A. D. 1400.

This comparison of two different sets of data gives a rainfall curve which can apparently be accepted with a good deal of confidence. Huntington, however, adopts a different interpretation; he considers that the long dry period preceding the formation of Lakes Pyramid and Winnemucca is the American representative of his Caspian drought of A. D. 650, and to make the dates fit he arbitrarily reduces Jones's determination of the age of these lakes by one-half. He states that "that is the earliest time when there is any evidence of so dry a period within historic times;" but it happens that there is abundant evidence of a prolonged dry period in Europe ending in 850 B. C., agreeing remarkably well with the combined evidence of the lakes and the trees in America.—*Nature*, February 23, 1926.

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, JANUARY 1926

By Señor J. B. NAVARRETE

[El Salto Observatory, Santiago, Chile]

(Translated by B. M. V.)

The month of January was characterized by relatively stable atmospheric conditions. During the first half, there were frequent pressure changes in the south, but on the other hand an anticyclone central at Chiloe dominated the situation almost without interruption during the second half.

Between the 1st and 3d a depression lay over the southern region, causing local showers between Valdivia and Magallanes. On the 4th the pressure rose in the south putting an end to the bad weather, but on the 5th it began to decrease again and between the 6th and 10th a period of bad weather with rains occurred between Valdivia and Chiloe. The greatest daily precipitation, 35 mm., was recorded at Valdivia on the 7th. After a transition period of calm on the 11th and 12th on the 13th it rained again between Concepcion and Magallanes, 38 mm. falling at Valdivia.

On the 14th, pressure rose decidedly in the south, becoming fully developed on the 15th, after which a major anticyclone became established at Chiloe, Huafo, and Raper, and lasted until the end of the month, with generally fine weather, prevailing southerly winds, and in the central zone intense hot waves. The highest temperature observed in this zone, 37° C., occurred at Talca on the 25th.

¹ "Quaternary Climates: Geologic History of Lake Lahontan," by J. Claude Jones; "On the Pleistocene History of the Great Basin," by Ernst Antevs; "The Big Tree as a Climatic Measure," by Ernst Antevs; "Tree Growth and Climatic Interpretations," by Ellsworth Huntington. (Publication No. 352.) Pp. v+212+10 plates. (Washington: Carnegie Institution, 1925.)